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ABSTRACT

Class size is a continuing concern for administrators and teachers in the Mesa Public School system. Research examined findings that reductions in class size can increase student achievement as measured by common standardized tests, but only if size is reduced to something below 20 students per class. Class size also produced changes in nonachievement areas such as attitudes, student participation, behavior, classroom management, quality of instruction and school climate. Reductions in class size were tremendously costly to implement. Projected costs for various class size reductions are presented. Appended are 20 references and five tables summarizing the class size research. (SI)

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CLASS SIZE IN MESA PUBLIC SCHOOLS: RESEARCH AND IMPLEMENTATION 1988

DR. LOU ANN S. DICKSON

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MESA PUBLIC SCHOOLS

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CLASS SIZE IN MESA PUBLIC SCHOOLS: RESEARCH AND IMPLEMENTATION 1988

DR. LOU ANN S. DICKSON

DR. JAMES K. ZAHARIS
SUPERINTENDENT

MR. DAVE EAGLEBURGER
ASSOCIATE SUPERINTENDENT
EDUCATIONAL SERVICES

DR. JAMES S. DEGRACIE
DIRECTOR, RESEARCH AND EVALUATION

MESA PUBLIC SCHOOLS
DECEMBER 1988

EXECUTIVE SUMMARY

Administrators routinely address questions from teachers, parents and students about possible reductions in class size. Students and parents within Mesa Public Schools (MPS) have expressed some concern with current class sizes in the district, but when surveyed, do not list class size as a significant problem. Class size continues to be an issue of interest to teachers. While there is an intuitive appeal to the idea of reducing class size: the issue is complex and the costs involved in even the smallest reduction in class size are high. As public resources continue to shrink, administrators are increasingly faced with decisions in which they must consider costs carefully while simultaneouly striving to maintain excellence in education for both the current and the coming generations of students.

Research in the area of the effects of class size is often contradictory and confusing, but some trends can be seen. Reductions in class size can increase student achievement as measured by standardized testing procedures, but only if size is reduced below 20 students per class. Class sizes from 20 to 40 students per class produce only superficial changes in achievement levels. Benefits of reductions can be primarily seen at the elementary level within grades K-3. Reading, arithmetic, language arts and study skills are the areas where benefits are most notable. Reductions at junior and senior high school levels have not been shown to produce consistent benefits if any at all. The exceptions here are students from disadvantaged or ethnic groups. Benefits for these groups extended to grades 4-8 for the subjects mentioned and further extended to high school level for reading and general academic ability.

Effects of classroom size can be seen in areas other than academic achievement, although these are often difficult to measure. Attitude, student participation, behavior, classroom management, quality of instruction and school climate are often linked to classroom size. The largest improvement in these areas as class size decreases however, are those related to the classroom teacher and the teaching process itself. This may be an indication of why size is more an issue with teachers than it is with parents or children.

The costs of implementing any reduction are high. Not only must additional teachers be hired, but additional space and certain administrative support services must be provided. Several approaches are possible for those wishing to reduce class size:

- All classes K-3 could be reduced to 15 students or less.
- Reduce only kindergarten, first, second or third grade classes to below 15 students per class.
- Identify struggling students in grades K-3 and place them in special small classes within each school.

- Place aides in each classroom K-3, to relieve the classroom teacher of paperwork and also to function as a tutor for students who need extra help.

Estimates of the costs are demonstrated in the following table. The initial costs are those anticipated in the first year and include both teachers' salaries and purchasing and setting up portables. Continuing costs are simply teachers' salaries as portable classrooms will be in place. All costs are in addition to current costs and do not include such items as increased administrative costs, janitorial and clerical services, maintenance, or utilities.

Possible reduction:	Additional		Costs:	
	Teachers	Portables	Initial	Continuing
All classes reduced by 1 student	88.1	39.6	$ 4,824,500	$ 2,646,500
Kindergarten only to 15:1	72.8	32.8	$ 3,989,000	$ 2,187,000
Grade 1 only to 15:1	153	68.9	$ 8,385,000	$ 4,596,000
Grade 2 only to 15:1	139	62.6	$ 7,617,000	$ 4,176,000
Grade 3 only to 15:1	150.3	67.7	$ 8,239,000	$ 4,515,000
K-3 inclusive to 15:1	515.1	231.8	$28,223,000	$15,474,000
One 15:1 class K-3 per school	143.5	213.8	$ 7,863,000	$ 4,311,000
Aide: all classes K-3	749 (aides)	0000	$ 7,473,000	$ 7,473,000

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CLASS SIZE IN MESA PUBLIC SCHOOLS: RESEARCH AND IMPLEMENTATION

A REVIEW OF RESEARCH

INTRODUCTION.

Class size is a continuing concern for administrators and teachers throughout the nation as well as within the Mesa Public School system. Faced with an era of shrinking fiscal resources and demands for educational reform, administrators must carefully evaluate class size and it's impact on student achievement, teacher satisfaction, and the educational climate. Simultaneously, this concern must be balanced against strict public charges for fiscal responsibility from administration.

If we were to inquire of parents, teachers or students whether they believe that small classes are better than large ones, common wisdom might indicate that we would receive a unanimous response in favor of smaller classes from all concerned. In reality, however, research does not provide clear substantiation of that common sense position. From 1977 to 1986 the Research and Evaluation Department of Mesa Public Schools conducted 3 extensive surveys (Thomas, 1985) of the affective dimensions of elementary schools at both an individual and a district level. Surveys were completed by teachers, parents and students and among the questions asked was one related to class size. Across all three surveys, parents and students indicated little concern that class size was too large, but teachers consistently cited this as a problem. Over the years, literally hundreds of studies have been conducted: some demonstrating that smaller is better while others propose the reverse and still others make no conclusion at all. This ambiguity in the research places decisions concerning class size among the more difficult that school administrators must make. The decision to reduce class size is fraught with emotional, political and economic issues and certainly has long-term implications for student learning, staff morale, and continued public support of the school system. The purpose of this survey of the available research literature is to seek commonalties across this research which can be employed in more informed decision-making to benefit the children of Mesa Public Schools not only in this generation but in those to come.

A MULTITUDE OF VARIABLES.

Traditional justifications for decreasing class size have focused on student achievement, ignoring other important classroom dimensions which do not lend themselves to easy measurement. Use of student achievement as the primary index of the effect of classroom size assumes that class size directly affects levels of achievement, ignoring such important factors as student intellectual ability, student and teacher effort, and classroom processes. In fact, Robinson and Wittebols (1986), propose 23 variables that can interact with class size and affect achievement. Even then, they do not claim the list is exhaustive. When we consider the actual distance between class size and student achievement as an end-product of learning, it becomes difficult to justify achievement testing as

the sole criteria. To more completely assess the impact of class size on students, we must address not only this end-product of student achievement, but also the effect of class size on the complex learning environment itself. This environment encompasses both students and teachers (and to some extent probably parents as well) and includes such considerations as cognitive processes, the affective climate, student developmental stages, and the type of subject being taught.

The body of research in this area dates from as early as 1900. By 1967, Furno and Collins reported over 300 studies on the effect of class size and we have had an additional 20 years of research added since that time. Unfortunately, many of these studies are poorly conceived and executed, producing data that is of questionable value. Glass and Smith (1978) evaluated 76 studies and determined that of that number, only 14 studies demonstrated good experimental control. Other studies are correlational in design, limiting their usefulness in establishing a cause and effect relationship. Many other studies are secondary analyses of other studies that may or may not have actually examined the class size variable originally.

Simply defining what constitutes "small" and "large" classes presents a problem in the research. Many studies define small as any class less than 20 students. More often small is defined as 25 to 30 students and on occasion classes as large a 45 have been included in the category of small. Simultaneously, other studies define classes of 25 as large. This lack of consensus in the basic concept of what is "small" or "large" presents enormous complications in determining the effects of class size. In addition to problems of research quality and definition of terms, there is a less obvious problem. While the classroom environment is multidimensional, most research has used a univariate approach to studies of class size, focusing only on the pupil or the teacher, or the teaching method. This presents a situation analogous to the fable of the blind men describing the elephant: we see many small pieces of the puzzle, but have no conception of the overall configuration.

STUDENT ACHIEVEMENT AND CLASS SIZE: A CONTROVERSY.

In recent years, the two primary players in research on class size have been Gene V. Glass and his associates and the Educational Research Service, Inc. (ERS). A primary focus of both these groups has been to examine the effect of class size on student achievement, but their approaches have been remarkably different. Glass is an academic researcher and statistician while ERS functions as a research survey component sponsored by 7 organizations involved in school management. Obviously each player has a different agenda. In 1978, ERS published a summary of research on class size concluding that this was a complex topic but that research evidence did not support the argument that smaller was better. They did acknowledge that there was some evidence that smaller classes in *lower* grades would have a positive effect on *reading* and *math* achievement, but temper this with cautions about the major budget impact of reducing classes by even one or two students per class.

The same year, Glass and Smith published a "meta-analysis" of studies relating to class size and student achievement. This meta-analysis selects prior studies according to predetermined criteria, integrates the findings of these studies, and conducts a statistical analysis of the selected research as if they were a single unit. This analysis provides a cross-study comparison of the findings of multiple studies which have been rendered equivalent through statistical

procedures. Meta-analysis might be compared to compiling several Shakespearean plays into one comprehensible production. Glass and Smith propose this approach provides a "rigorous alternative" to the typical narrative discussion which has characterized prior attempts to analyze this body of research.

Claiming their approach enabled them to make "bold generalizations" where other reviewers could only propose "timid qualifications," Glass and Smith examined 14 well-controlled studies on class size and student achievement and proposed an increase of 30 percentile ranks in achievement when a student is taught individually as opposed to a class of 40. There appears, however, to be a leveling off of improvement somewhere between 20 and 25 students per class with an achievement difference of only 6 percentile ranks between classes of 20 and 40 students. The researchers suggest that to obtain the best results from smaller class size, the classes should certainly be less than 20 and preferably not larger than 15. With classes above 30 students it seems to make little difference how large they are. Smith and Glass (1979) followed this study immediately with a companion meta-analysis examining the effects of small classes on the overall learning environment This study focused on variables which affect students, teachers, instructional processes and the educational environment. The results of this second study supported many of the conclusions of the first meta-analysis.

ERS (1980) responded immediately to what they termed Glass and Smith's "extraordinary reviews of class size" with an unauthored critique which was at best negative and at worst scathing in its attack on the meta-analysis. Points of concern were that the technique obscured important information in class size research, that the analysis was based only on a few studies, that the methodology was inconsistent and the conclusions overgeneralized, that interpretations were often contradictory, and that conclusions confused the class size issue and encouraged class size reductions. Additionally ERS was concerned that the "bold generalizations" claimed by Glass and Smith would be interpreted as the last word on class size, discouraging further research.

In direct response to the ERS critique, Glass and Smith reordered, reorganized and republished the analyses in book form (Glass, Cahen, Smith and Filby, 1982). They included invited comments from a number of prominent educators and administrators addressing the importance and implications of the research for educational policy and openly challenged the reader to decide "Which research do you trust?"

Concerned about methodological problems in the Glass and Smith meta-analyses, Hedges and Stock (1983) found the analyses to be open to criticism in several areas. They reanalyzed the data using statistical methods they termed "rigorously justified" and generally preferable to the methods of the original investigators. They concluded that while the approach of Glass and Smith was possibly less than optimal, nonetheless, the results were not demonstrably different using the more rigorous approach. Preece (1987) also examined the same data as Glass and Smith in testing a theoretical model designed to take into account the idea that teachers adapt and pace instruction to the needs of the least capable student and the amount of instruction given. Preece's analyses substantiated the findings of Glass and Smith.

In 1986, ERS again returned to the class size controversy and published a research brief authored by Robinson and Wittebols. They use what they term a "Related Cluster Analysis" approach, proposing that this procedure makes the body of research more understandable and useful to administrators. The authors compare the meta-analysis of Glass and Smith with Related Cluster Analysis, claiming superiority for their methodology because it sorts specific areas (e.g. reading, social science etc.) from the overall body of research. They readily acknowledge, however, the small number of research studies available for any particular specialty. Closer examination of the methodology of Related Cluster Analysis reveals this to be a non-statistical selection and sorting of studies resulting in a compounding of the problem they decry in the meta-analysis: that of basing an analysis on a limited number of studies which have been judgmentally selected. Carrying a critique of the methodology further, we find that no statistic is applied in this analysis to produce a measure of comparison, but rather, the sorted studies are merely examined subjectively and conclusions drawn on the basis of what is seen: an eye-ball analysis of sorts. To say it is difficult to equate "Related Cluster Analysis" with meta-analysis as an analytical tool is to be given to severe understatement. Ignoring this rather loose approach to analysis of the data, it is interesting to find that, in general, the findings of ERS do not differ substantially from those of the two meta-analyses of Glass and Smith.

The conclusions of a survey of class size research done in 1988 by Tomlinson for the U.S. Department of Education (USDE) were markedly different from those of ERS or Glass and Smith. This narrative study simply examined the bulk of the past literature on the subject and concluded that while smaller classes hold an intuitive appeal for parents and teachers, reducing class size is not likely to improve student performance. He notes that during the past 100 years there has been a steady decline in pupil/teacher ratios in public schools from nearly 38:1 in 1897 to nearly 18:1 in 1987. These ratios are somewhat deceptive, however, in that they include persons classified as teachers who are in administrative positions and who may never face a classroom of students. Additionally, included in these figures are students needing special attention (e.g. Special Education, English as Second Language) and the additional teachers to provide it. In reality classes are nearly always larger than the pupil/teacher ratio indicates. A better index might be that of pupils per class. The USDE report indicates that the median number of pupils per class has fallen from 30 in 1961 to 24 in 1986 for elementary schools and from 27 in 1961 to 22 in 1986 for secondary schools.

The Tomlinson (1988) report also looked at class size and achievement and an interesting pattern emerges: with rare exception, as class size has decreased so have standardized achievement scores. This presents the paradox of the smallest classes in the history of U.S. schools producing the lowest test scores. Many explanations have been offered for this phenomena, none of them very satisfactory. Included in these explanations have been the need for curriculum reform, tests which do not reflect today's teaching, and unfavorable secular trends producing an anomalous generation of students. Considering the enormous costs and uncertain benefits of even a small reduction in class size, Tomlinson finds this approach to raising test scores not at all cost-effective. At the very least, the report recommends careful consideration be given to *which* students will benefit and *how* and *why* they will benefit. Tomlinson recommends approaches designed to increase teacher competence, pointing out that this in itself will lighten teacher loads and raise student achievement. In

reality we must also recognize this survey may have substantial political overtones, issued as it is from an administration which has clearly stated they do not want to spend additional money on education.

ACHIEVEMENT IN SCHOOLS WHICH HAVE REDUCED CLASS SIZE.

If we examine achievement scores in schools where reductions in class size have actually been implemented, we receive a less esoteric view of what can conceivably happen. A district in Tennessee established an experimental school to study the effects of reducing class size from 25 to 15 for grades 1-3. In evaluating the results of this reduction in class size on first graders (Whittington, Bain & Achilles, 1985; Bain & Achilles, 1986), experimental (15:1 ratio) and control (25:1 ratio) groups were matched on the following factors: sex, race, economic status, birthdate, and CAT scores. A second district wide blind control group was selected and matched with the prior two groups. The rest of the district first graders served as a group for baseline data. Pretests (CAT 10) were administered followed one year later by posttests (CAT 11). Examination of pretest scores for both reading and math did not indicate any substantial differences among these groups. Analysis of posttest scores demonstrated that students in the experimental group (15:1 ratio) scored substantially higher than any other group in both subjects. When gain scores from pre- to post test were examined, controlling statistically for differences in pretest scores, the experimental group excelled again. Smaller classes clearly presented advantages for this group of students.

Indiana phased in a statewide reduction in class size for grades K-3. First grade classes were studied for three years during this phase in and scores from the Iowa Tests of Basic Skills were analyzed across the three years (Bain & Achilles, 1986; Swan, Stone & Gilman, 1987). Average class sizes for the three years were 23.7, 19.9, and 16.1. Math scores (percentiles) across the three years increased significantly each year from 59.3 to 70.0 to 79.1, an increase of approximately 20 percentiles. This increase would support the predictions of Glass and Smith (1978). Reading percentiles increased significantly the first year from 71.4 to 80.7. From the second to the third year, however, there was a slight decrease to 79.9, suggesting that a ceiling effect may have been reached. Composite scores on the ITBS also increased steadily over the three years from 58.4 to 76.3 to 80.6 with the gain from year 1 to 2 being significant but that from year 2 to 3 being nonsignificant, further supporting the idea of a ceiling effect at a score of about 80. Second grade scores were tracked for two years and a significant increase in scores was seen on math and composite scores, but not on reading scores. While the program appears to have been a success, gains were greatest for the first year of its implementation.

CLASS SIZE AND CULTURE.

When we examine the research, it becomes apparent that culture has a marked effect on class size and achievement. If we examine the top 20 nations ranked for U.S. equivalent 8th grade mathematics classes in 1982, we find Japan having the 3rd largest average class size (41) yet ranks 1st in test scores. By contrast, Luxembourg has the smallest average class size (19) and ranks 18th on test scores. The U.S. and Hungary both have relatively small average class sizes (26) yet Hungary ranks 3rd and the U.S. ranks 14th on test scores. Hong Kong has the largest classes (44) and ranks 8th on scores. We hasten to point out that it is possible that if Japanese classes were reduced in size to approximate those found in the U.S., Japanese students might do even better.

It is apparent that factors other than class size are operating in the international scene. Several studies (Suter, 1987; Cuban, 1986, Goodlad, 1984, Sirotnik, 1983) indicate that teaching quality, instructional methods, mathematics instructional time and homework time (excluding tutoring) spent on mathematics do not differ among schools in the U.S. and Japan. If anything, students in the U.S. spend more time in school on mathematics when compared to Japanese students. What does differ, however, is the Japanese students' perception that learning is accomplished through hard work and that if they have difficulty they must simply work harder. Teachers, in turn, have high expectations for students and see learning shaped by steadily pushing students to excellent performance. Classrooms are designed for self-control and cooperative learning styles, freeing teachers from many control problems found in U.S. schools, and there is a national uniformity in curriculum and instructional methods which ignores individual differences and concentrates on achievement (U.S. Department of Education, 1988). In addition, there is competition for education at higher levels in Japan and social status is often determined by educational levels. Parents and students are acutely aware of this and focus resources and energy toward that competitive structure.

With an overall picture of the research in mind, we will now turn to examining several of the variables other than student achievement which we initially proposed to be important: affective climate, student age, and subject being taught.

AFFECTIVE CLIMATE AND CLASS SIZE.

In the second meta-analysis, Smith and Glass analyzed 130 studies which had addressed non-achievement effect of class size. These included studies on such issues as student attitudes, individualization of instruction, student participation, enrichment activities, classroom behavior, interpersonal regard, quality of instruction, teacher attitude, open education, and school climate. They concluded that reductions in class size have beneficial effects on both pupil and teacher affective outcomes and on the teaching process itself. Overall they propose an increase in achievement scores of 35 percentile points between a class of 5 and a class of 40 which can be attributed to the quality of the educational environment. While there were substantial effects on both students and the instructional process, the most dramatic related to teachers (e.g. morale, attitude toward students, satisfaction, absences, workload, professional growth). Lindbloom (1970) found that the main support for decreases in classroom size comes from studies on teaching processes, not on student achievement. Teachers feel better and feel they teach better in smaller size classes.

AFFECTIVE CHANGES IN SCHOOLS WHICH HAVE DECREASED CLASS SIZE.

Indiana (Bain & Achilles, 1986; Swan, Stone & Gilman, 1987) initiated a stepped reduction in class size from 24 to 16 over a 2 year period of time and used a Likert-type scale to examine the effects of this reduction on student self-concept and attitudes toward school. Student self-concept increased significantly each year of the two year period. Student attitudes toward school improved significantly the first year and then leveled off the second. In Tennessee (Whittington, Bain & Achilles, 1985; Bain & Achilles, 1986) where they established the experimental school to evaluate the effects of class size, the primary focus of the project was to examine student achievement. In addition, teachers were asked to keep logs to provide qualitative information on the effects of smaller classes on teaching processes and student behavior. Findings indicated that small classes were quieter, students participated more, discipline

problems were identified and resolved more quickly, more learning activities occurred, instruction was more individualized, monitoring of on-task behaviors improved, and student interactions became more positive and cooperative.

STUDENT AGE AND CLASS SIZE.

The effect of class size varies significantly depending on the age of the students. Robinson and Wittebols (1986) found 55 studies which made 65 grade-level comparisons of the effect of class size (Appendix 1). The results of these comparisons were classified as favoring small classes, favoring large classes or favoring neither small nor large classes. In studies of K-3, the ratio of studies favoring small classes was 5.5:1, an impressive positive effect of smaller classes. The sizes of classes in these studies ranged from 13 to 29 for "small classes" and 22 to 40 or more for "large classes," reminding us of the difficulty in establishing a definition of what constitutes small/large classes. In studies of grades 4-8, the ratio favoring smaller classes was 2.7:1 giving a slight positive effect for the smaller classes. In grades 9-12, the ratio of studies favoring small classes dropped to 1.3:1, indicating little positive effect of smaller class sizes. In fact, the largest number of studies in this grade range found no differences related to class size. Identical problems relating to definitions of sizes can be seen in classes from 4-8 and 9-12.

SUBJECT TAUGHT AND CLASS SIZE.

From the Robinson and Wittebols survey (1986) on the effect of class size by age of students, we saw that the grades most likely to profit from smaller classes were those of K-3. In this age group, reading, arithmetic, language arts and study skills scores improved as class size declined. In grades 4-8, the effect of class size was not so great as in K-3, but could be seen in reading, math, language, social studies, and art. At the 8-12 grades levels, however, a somewhat different pattern is seen: 50% of the studies on reading favored small classes, but none (0%) of the studies on math favored small classes. Here we see either a positive effect for larger classes or no effect at all. Studies on the effect of class size on instruction in the sciences indicated the grades 9-12 only 14% of the studies favored smaller classes. A problem here is that there are so few studies in any one area that it is difficult to draw conclusions. In any event, larger classes, up to 45 or more students, did not seem to inhibit student learning.

DISADVANTAGED OR ETHNIC STUDENTS AND CLASS SIZE.

Studies of the effects of class size on the achievement of disadvantaged or ethnic students is very limited. Robinson and Wittebols (1986) found only 13 studies that examined these areas specifically. In addition 8 other studies were found which did not directly address these topics but in which the students were primarily members of these two categories. Among disadvantaged or ethnic students in K-3, 56% favored smaller classes and in grades 4-8, 80% of studies favored smaller classes. In the 9-12 group only one study of black students was available and it found smaller classes related to better scores in reading and general academic ability, but not in mathematics.

COSTS OF DECREASED CLASS SIZE.

Critics of implementing programs designed to reduce class size have cited figures proposed by Tomlinson for the USDE (1988) in which they cite a reduction of the national average class size from 24 to 15 requiring 1 million additional teachers and $69 billion in funding. These figures do not include the enormous expense of building sufficient classrooms to house the additional

classes. Rehmus and Wilner (1968) cite an increase in the cost of teachers' salaries alone of 16 2/3% to decrease class size from 30 to 25, a decrease that Glass and Smith do not predict will increase student achievement significantly. The costs of decreasing class size to below 20 students per class, the point at which Glass and Smith predict performance improvement, would cost substantially more. In the statewide program to reduce class size to less than 18 in Indiana, implemented in 1984, the legislature appropriated more than $100 million for the first 3 years of the program.

On the other hand, it may be that large class room size presents unique costs of its own, costs which may be nearly impossible to measure: repetition of classes, truancy, discipline problems, dropouts, public assistance, and delinquency are a few. If we can increase student achievement as Glass and Smith propose by 36% by decreasing class size, can we then decrease spending in these troublesome areas by an equally remarkable amount? Unfortunately there is no easy answer.

SUMMARY.

When we examine the body of research we find that reductions in class size can increase student achievement by substantial amounts as measured by common standardized tests, but only if size is reduced to something below 20 students per class. Class sizes from 20 to 40 students cause only superficial changes in student achievement. Benefits of reductions are primarily focused at the elementary level and there within grades K-3. Reduction at the high school level have not been found to produce noticeable differences.

When attention was focused on the subject matter taught, reading, arithmetic, language arts and study skill scores improved in the K-3 grade levels. At grades 4-8 the same subjects benefitted, but to a lesser degree, and at high school levels, reading was the only class where any noticeable benefit was found and that was small.

Class size also produces changes in non-achievement areas such as attitudes, student participation, behavior, classroom management, quality of instruction and school climate. Mesa students and parents have, on occasion, expressed some concern about class size, but when surveyed they have not viewed current class size as a significant problem. District teachers, on the other hand, consistently list it as a concern. This is not surprising since studies of non-achievement effects find the greatest impact of reduction of class size on teachers and the teaching process itself.

In examining the effects of smaller classes on disadvantaged or ethnic students, we found few studies which examined these areas specifically. However, the existing research indicates substantial benefit to these students by classroom size reductions. Reversing trends with the overall student population, disadvantaged or ethnic students not only benefitted from reduced size in K-3, but also equally as much from reductions in 4-8. At the high school level, reading and general academic ability was enhanced for these students, but no effect was found on math.

International studies indicate that cultural factors may be important. Japanese students, a very homogeneous group when compared with the U.S., relate achievement and hard work with little emphasis on ability. Uniform national

curriculum, competition for advanced education, and high teacher expectations also function to increase performance despite class sizes of 40 or more students.

An important and consistent finding of the research was that reductions in class size were tremendously costly to implement. Even small reductions, which might not be necessarily cost-effective, ran to millions of dollars. With this in mind, we will now turn to examining the cost to Mesa Public Schools in implementing several possible alternatives in reducing class size.

IMPLEMENTATION

PROJECTED COSTS FOR VARIOUS CLASS SIZE REDUCTIONS

ASSUMPTIONS AND COST ESTIMATES.
Our projections in this section are based on the following assumptions and cost estimates:

- Student enrollment is as of October 29, 1988. We assume stability.
- Teacher census is as of November 5, 1988. We assume stability.
- Chapter 1 or Foundational Skills Teachers are not included.
- Only actual classroom teachers are included so our estimates reflect actual students per class with the following exceptions:

  1. Our estimated class size ratios do not reflect the fact that many students are pulled from classes for various reasons. For example, students may be removed from class for the following subjects, (this is not an exhaustive list):
     - Band
     - Art
     - Music
     - Athletics
     - Drama
     - Debate
     - Cheer/Pom lines
     - Gifted programs

  2. Many students are enrolled at one high school but attend classes at Mesa Vo-Tech High School for part of the day. The end result is a smaller pupil/teacher ratio than that which is actually demonstrated.
  3. Self contained special education students are generally in classes of 15 or less and have not been included in our estimates nor are any special education teachers.

- Students are enrolled in grades 7-9 for 6 classes per day.
- Students are enrolled in grades 10-12 for 5.5 classes per day.
- Kindergarten teachers teach 2 classes per day.

- Teachers for grades 7-12 teach 5 classes per day.

- Costs shown are in addition to current costs.

- No cost estimates are included for additional administrative interns, clerical or janitorial staff, utilities, building maintenance, district administration costs, increased transportation needs, or teachers' desks and supplies.

- Substitute teacher costs are estimated at $45.00 per day per teacher. We assume a teacher will be sick an average of 6 days per year at an annual cost of $270.00 per teacher.

- Teacher salary and costs are estimated as follows:

Base salary	$24,500.00
FICA	1,857.00
Unemployment insurance:	25.00
State Compensation	142.00
State Retirement	1,247.00
Health Insurance	5,016.00
Sick days (substitute)	270.00
TOTAL	$30,040.00

- No new buildings will be built. Portables will be used as needed and 2 classrooms will be contained within each single portable unit. Estimated cost of purchasing one portable is $40,000.00 and the cost of set-up, including ground work and bringing in utilities, is estimated at $15,000.00. This a nonrecurring cost and will be estimated both jointly and separately. It should occur only in year 1.

- Of new classes created by decreasing class sizes, 10% will be absorbed into current structures and will not require additional portables.

For calculating various reduction and estimating the costs of such reductions, we established a baseline for total students, teachers, and present class sizes based on figures for October 1988. The following table presents baseline data upon which subsequent calculations for reductions in class size were based. Included in this table are the Mesa Public Schools mean class sizes by grade and teacher counts. Excluded are special education students, students at Mesa Vista and Mesa Vo-Tech High schools, and students in special programs (e.g., TAPP, Mesa Vista, SHARP).

TABLE 1: MEAN CLASS SIZES

	K	1	2	3	4	5	6	*7	*8	*9	^10	^11	^12
Students:	5468	5895	5160	5172	4951	4591	4709	*4351	*4069	*3931	^4078	^3653	^3721
Teachers:	°109.5	240	205	194.5	171	158.5	156	*544.9			^493.3		
Ratio:	25.0	24.6	25.2	26.6	29.0	29.0	30.2	27.2			25.5		

°Each teacher teaches 2 classes.

Looking at these same figures by various levels we find the following:

	K	K-3	K-6	*7-9	^10-12	Totals
Students:	5468	21,695	35,946	*12,351	^11,452	59,749
Teachers:	219	858.5	1,344	*544.9	^493.4	2,382.3
Ratio:	25.0	25.3	26.7	27.2	25.5	

* Students enroll for 6 classes and teachers teach 5 class periods.
^ Students enroll for 5.5 classes and teachers teach 5 class periods.

Mesa Public Schools TOTALS:
Students: 173,038 (student periods at 7-12)
Teachers: 6,535.3 (teacher periods at 7-12)
Ratio: 26.5

DECREASING CLASS SIZE ACROSS ALL SCHOOLS.
Glass and Smith proposed that unless classroom size was reduced to below 20 it was probably not an effective approach. Simultaneously, ERS (1978) warned of the enormous costs of reducing class size by only 1 student per class. While that kind of reduction is not cost-effective, it is instructive to examine the costs to Mesa Public Schools in simply reducing all classes by one student (exclusive of special education classes and those at Mesa Vista and Mesa Vo-Tech schools.) Table 2 gives the estimated costs of this kind of across the board cut in student/teacher ratios for Mesa Public Schools.

Table 2: ESTIMATED COSTS TO DECREASE AVERAGE STUDENT/TEACHER RATIOS ACROSS ALL CLASSES IN MESA PUBLIC SCHOOLS BY 1 STUDENT (EXCLUDING SPECIAL EDUCATION AND MESA VISTA AND MESA VO-TECH SCHOOLS)

CLASS	NUMBER STUDENTS:	PROJECTED CLASS SIZE:	TEACHERS: PROJECTED	CURRENT	NEEDED
K	5468	24.0	113.9	*109.5	4.4
1	5895	23.6	249.8	240.0	9.8
2	5160	24.2	213.2	205	8.2
3	5172	25.6	202	194.5	7.5
4	4951	28	176.8	171	5.8
5	4591	28	164	158.5	5.5
6	4709	29.2	161.3	156	5.3
7-9	74,106 (hrs)°	26.2	565.7°	544.9	20.8
10-12	62,986 (hrs)^	24.5	514.2^	493.35	20.8
TOTAL NEW TEACHERS NEEDED:					88.1

*All teachers teach 2 classes.
°Students enroll for 6 classes and teachers teach 5 class periods.
^Students enroll for 5.5 classes and teachers teach 5 class periods.

IMPLEMENTATION COSTS

	ITEM:		COST:	STATUS:
88.1	New Teachers:	Salary:	$2,646,500	recurring
39.6	Portables	Purchase:	1,584,000	nonrecurring
		Set Up:	594,000	nonrecurring

(SUBTOTAL FOR NONRECURRING COSTS: $2,178,000)

FIRST YEAR implementation costs:	$4,824,500
SUBSEQUENT YEARS' implementation costs:	$2,646,500

DECREASING ONLY KINDERGARTEN CLASSES TO 15:1 RATIOS.
While it is not cost-effective to reduce all classes by one, the previous figures give us an indication of the costs involved in any reduction of class size and the responsibility to be fiscally responsible in these approaches. The research indicates that reductions are more effective in the lower grades and if we seek a cost-effective solution, it may be more realistic to focus reductions in the K-3 areas. Table 3 gives estimated costs for reducing all kindergarten classes to 15:1 ratios.

Table 3: ESTIMATED COSTS FOR REDUCING KINDERGARTEN ONLY FROM 25.1 STUDENTS/CLASS TO 15 STUDENTS/CLASS. (SPECIAL EDUCATION EXCLUDED)

STUDENTS IN K:	PROJECTED CLASS SIZE:	TEACHERS: PROJECTED	CURRENT	NEEDED
5468	15	*364.5	*109.5	72.8

*Each teacher teaches 2 classes.

IMPLEMENTATION COSTS

	ITEM:		COST:	STATUS:
72.8	Teachers:	Salary:	$2,187,000	recurring
32.8	Portables:	Purchase:	1,312,000	nonrecurring
		Set-up:	492,000	nonrecurring

(SUBTOTAL FOR NONRECURRING COSTS: $1,804,000)

FIRST YEAR implementation costs:	$3,991,000
SUBSEQUENT YEARS' implementation costs:	$2,187,000

REDUCING FIRST GRADE CLASSES TO A 15:1 RATIO.
The costs of reducing kindergarten classes are somewhat lower than the costs of reducing say first or second grades because kindergarten teachers teach 2 classes per day, a morning and an afternoon class. Decreasing class size then requires only one-half the teachers for kindergarten that would be required for other classes. Examining the estimated costs of reducing all first grade classes to a 15:1 ratio indicates the costs involved in reducing primary grades. Table 4, presents these costs.

Table 4: ESTIMATED COSTS FOR REDUCING FIRST GRADE ONLY FROM 24.6 STUDENTS/CLASS TO 15 STUDENTS/CLASS. (SPECIAL EDUCATION EXCLUDED)

STUDENTS	PROJECTED		TEACHERS:	
GRADE 1:	CLASS SIZE:	PROJECTED	CURRENT	NEEDED
5895	15	393	240	153

COSTS

	ITEM:	COST:	STATUS:
153 Teachers:	Salary:	$4,596,000	recurring
68.9 Portables:	Purchase:	$2,756,000	nonrecurring
Set-up:		1,033,000	nonrecurring

(SUBTOTAL FOR NONRECURRING COSTS: $3,789,500)

FIRST YEAR implementation costs:	$8,385,000
SUBSEQUENT YEARS' implementation costs:	$4,596,000

REDUCTIONS FOR OTHER GRADES OR COMBINATIONS OF GRADES.

• Estimated costs for reducing grades within the elementary school level are presented as follows:

	initial:	continuing:
* grade 2 : (Appendix 2).	$7,617,000	$4,176,000
* grade 3 : (Appendix 3).	$8,239,000	$4,515,000
* K-3 : (Appendix 4).	$28,223,000	$15,474,000

• Another cost-effective approach might be an approach suggested by Tomlinson: to identify which students could benefit most from reductions and implement smaller classes for those students. Students who do not qualify for Transitional 1 classes, but are determined by the teacher and by performance on standardized test to be underachievers could be placed at the appropriate grade, but in classes with a ratio of approximately 15:1. In essence, this would be ability grouping students in the early grades to allow struggling students who do not qualify for special programs to function in a classroom where they can obtain maximum assistance. To accomplish this for K-3 would require the addition of 4 classes per school, one for each of the grades indicated. Estimated costs for this type class size reduction would be substantially less than for an overall reduction in K-3, but would also focus on students most likely to benefit from smaller classes and at a developmental stage which the research indicates is a prime time for such intervention. We can anticipate a slight decrease (approximately 2.5 students / class) for all classroom sizes in the affected grades as students are removed from the regular class and placed in the reduced size class. This decrease in size is not sufficient to predict any noticeable benefits to student achievement, but rather is incidental to the formation of the smaller class. Estimated costs for implementing such a reduction in MPS are estimated to be $7,863,000 for the year of implementation and $4,311,000 for subsequent years (Appendix 5).

• A variation related to the above reduction which would not increase costs substantially would be to maintain the number of classrooms and teachers at the present levels but designate one classroom within each grade (say K-3) to be a reduced class with a 15:1 ratio. This would result overall in a slight increase (approximately 1.9 students / class) in class size for the other classrooms as students from the reduced size class are distributed among other teachers and classrooms. This increase in class size is not sufficient to predict significant effects on either student achievement or non-achievement variables, but is simply incidental to formation of the smaller class. There would be no anticipated increased costs in implementing this strategy.

• An approach which might be less costly but still effective is one in which teachers focus primarily on teaching activities, spending increased time on these while allied personnel perform non-teaching activities. This approach could be implemented by providing each class in grades K-3, for example, with not only a teacher, but also with a full time teachers' aide to facilitate paperwork, tutor individual students who need additional attention and perform other non-teaching duties that might be supervised by the teacher. These personnel would be less expensive and, in essence, would provide the equivalent of a substantial reduction in class size for teachers. While we do not propose an aide as equivalent to a full-time teacher, the aide could effectively increase teaching time available to the teacher by possibly one-third. Considering an aide as increasing teaching time by 33%, costs for implementing this kind of approach for K-3 are estimated to be $7,473,000 for both implementation and continuing years' costs (Appendix 6). An approach related to this has been implemented in Sirrine School in MPS where aides and students from the College of Education at Arizona State University have been assigned to many of the classes. The ultimate result is to lower effective class sizes substantially. However, a problem in implementing this procedure is that classroom teachers must supervise the aides and student teachers. Many of the teachers at Sirrine School express considerable discomfort at this supervision task and state they would rather have larger classes than be responsible for supervising other adults. It may be important to monitor this situation and provide additional training in adult management skills for teachers who might be involved in this situation.

APPENDIX 1:

**CLASS SIZE AND STUDENT ACHIEVEMENT:
STUDIES CLUSTERED BY GRADE LEVEL
(ROBINSON & WITTEBOLS, 1986, PG. 67)**

GRADE LEVEL	TOTAL STUDIES:	FAVOR SMALL	NEITHER	FAVOR LARGE	RATIO SMALL/LARGE	PERCENT FAVOR SMALL
K-3	22	11	9	2	5.5:1	50.0%
4-8	21	8	10	3	2.7:1	38.1%
9-12	22	4	15	3	1.3:1	18.2%

NOTE: Data from 65 grade-level comparisons contained in 55 separate studies of class size and pupil achievement, 1950 to 1985.

APPENDIX 2:

ESTIMATED COSTS FOR REDUCING SECOND GRADE ONLY FROM 25.2 STUDENTS/CLASS TO 15 STUDENTS/CLASS. (SPECIAL EDUCATION EXCLUDED)

STUDENTS GRADE 2:	PROJECTED CLASS SIZE:	TEACHERS: PROJECTED	CURRENT	NEEDED
5160	15	344	205	139

IMPLEMENTATION COSTS

	ITEM:	COST:	STATUS:
139	Teachers: Salary:	$4,176,000	recurring
62.6	Portables: Purchase:	$2,502,000	nonrecurring
	Set-up:	939,000	nonrecurring
	(SUBTOTAL FOR NONRECURRING COSTS:	$3,441,000)	

FIRST YEAR implementation costs: $7,617,000
SUBSEQUENT YEARS' implementation costs: $4,176,000

APPENDIX 3:

ESTIMATED COSTS FOR REDUCING THIRD GRADE ONLY FROM 26.6 STUDENTS/CLASS TO 15 STUDENTS/CLASS. (SPECIAL EDUCATION EXCLUDED)

STUDENTS GRADE 3:	PROJECTED CLASS SIZE:	TEACHERS: PROJECTED	CURRENT	NEEDED
5172	15	344.8	194.5	150.3

COSTS

	ITEM:	COST:	STATUS:
150.3	Teachers: Salary:	$4,515,000	recurring
67.7	Portables: Purchase:	$2,708,000	nonrecurring
	Set-up:	1,016,000	nonrecurring
	(SUBTOTAL FOR NONRECURRING COSTS:	$3,724,000)	

FIRST YEAR implementation costs:	$8,239,000
SUBSEQUENT YEARS' implementation costs:	$4,515,000

APPENDIX 4:

ESTIMATED COSTS FOR REDUCING GRADES K-THREE FROM PRESENT LEVELS TO 15 STUDENTS/CLASS. (SPECIAL EDUCATION EXCLUDED)

CLASS	NUMBER STUDENTS:	PROJECTED CLASS SIZE:	TEACHERS: PROJECTED	CURRENT	NEEDED
K	5468	15	*364.5	*109.5 (X2)	72.8
1	5895	15	393	240	153
2	5160	15	344	205	139
3	5172	15	344.8	194.5	150.3
K-3	21,695	15	1,446.3	858.5	515.1

* Each teacher teaches 2 classes

IMPLEMENTATION COSTS

	ITEM:		COST:	STATUS:
515.1	Teachers:	Salary:	$15,474,000	recurring
231.8	Portables:	Purchase:	$ 9,272,000	nonrecurring
		Set-up:	3,477,000	nonrecurring
		(SUBTOTAL FOR NONRECURRING COSTS:		$12,749,000)

FIRST YEAR implementation costs:	$28,223,000
SUBSEQUENT YEARS' implementation costs:	$15,474,000

APPENDIX 5:

ESTIMATED COSTS FOR PROVIDING EACH ELEMENTARY SCHOOL WITH ONE ADDITIONAL CLASS HAVING A RATIO OF 15:1 FOR GRADES K-3.

TEACHERS NEEDED:

Number of elementary schools:	41
Kindergarten teachers:	*20.5
Grade 1-3 teachers:	123.0
TOTAL NEW TEACHERS NEEDED:	143.5

*Each teacher teaches 2 classes.

PORTABLES NEEDED:

New classes:	143.5
10% rate of absorption:	14.3
2 classes/portable:	64.6

COSTS

ITEM:	COST:	STATUS:
143.5 Teachers: Salary:	$4,311,000	recurring
64.6 Portables: Purchase:	$2,584,000	nonrecurring
Set-up:	969,000	nonrecurring

(SUBTOTAL FOR NONRECURRING COSTS: $3,553,000)

FIRST YEAR implementation costs: $7,863,000
SUBSEQUENT YEARS' implementation costs: $4,311,000

APPENDIX 6:

ESTIMATES FOR PROVIDING EACH CURRENT CLASSROOM TEACHER GRADES K-3 WITH A CLASSROOM AIDE

We cannot consider a teacher and an aide equivalent. While an aide will free a teacher to do more actual teaching and less clerical work, adding an aide is not the equivalent of adding an additional classroom teacher. If we consider an aide as the equivalent of 33% of a full-time teacher we get the following effective class size ratios:

Current classroom sizes (see Table 1):		Aides:	Effective size:
Kindergarten:	25.1	*109.5	16.8
Grade 1:	24.6	240	16.5
Grade 2:	25.2	205	16.9
Grade 3:	26.6	194.5	17.8
		Total: 749	

*Each aide would assist 2 classes.

The salary range for classroom aides is currently $5.69 to 6.54 per hour. If 749 classroom aides were hired at $6.01 per hour, for 30 weeks per year, the salary package would be approximately:

Base salary:	$7,212
FICA:	547
Unemployment:	7
State Compensation:	42
State Retirement:	367
Health Insurance:	1562
SUBTOTAL:	$9737
6 sick days at $40 per day for replacement:	240
TOTAL:	$9977

To provide each current classroom teacher in K-3 with an aide, assuming no such positions currently exist, we would need 749 aides. There would be no need for additional classrooms since all aides would be absorbed into current classrooms. Cost estimates therefore are:

YEARLY IMPLEMENTATION Costs for aides $7,473,000

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